

**UNSTABLE RISK MANAGEMENT SYSTEMS:
THE EVOLUTION OF AN
'INTELLIGENT BUILDING' IN SINGAPORE**

by

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ABSTRACT

The research presented in this thesis demonstrates that in the management of risks arising from the development of complex socio-technical systems there are four contingent organisational states described as:

- Type 1 - High Reliability Organisation
- Type 2 - Normal Accidents Organisation
- Type 3 - Low Reliability Organisation
- Type 4 - Murphy's Law Organisation

This thesis has shown that negentropy and redundancy are the forces that seek to achieve effective organisational behaviour and lead to a more steady predictable Type 1 state of algorithmic organisational stability. However, such stability is contingent upon limiting, as far as possible, environmental disturbances. If systemic overload and instability increase significantly during decision toward implementation, high reliability may not eventuate and a crisis may unfold.

Redundancy and anticipation are important in order to achieve effective and/or efficient operations with rational decision-making and negative feedback control loops. However, resilience may be more important when decision-making is non-rational, lead times are less than lag times and where economy or equity and positive feedback loops provide a more appropriate fit with the environment.

In conclusion, this research has shown that likelihood and consequence of surprises in a complex socio-technical system (an Intelligent Building project for a bank in Singapore) are contingent upon the causal texture of the environment, the dominant risk culture of the key stakeholders, and the dynamic reliability of the system determined by the ratio of lead to lag times and gain to load. Redundancy and negative feedback are important particularly in rational decision systems. Resilience and positive feedback are important

in non-rational decision systems. Instability and surprise can occur in transition from one decision state to another, especially during overload conditions. A decision-paths' schema is developed to show that the Intelligent Building as originally intended did not eventuate. This thesis thus demonstrates the analytic value of contingency theory.

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GLOSSARY OF ABBREVIATIONS

+ve	positive
-ve	negative
A/V	Audio Visual
APEC	Asia Pacific Economic Forum
ASEAN	Association of South East Asian Nations
AT&T	American Telephone and Telegraph Company
ATM	Asynchronous Transfer Mode
ATM	Auto Teller Machine
B.G.	Brigadier General
BACNet	Building Automation Control Network
CCTV	Closed Circuit Television
Consultel	Consultel Australia Proprietary Limited
CPM	Critical Path Method
CPPL	Credit POSBank Private Limited
CSCP	Civil Service Computerisation Programme
DBS	Development Bank of Singapore
DBSP	DBS Property Private Limited

EDB	Economic Development Board
EDI	Electronic Data Interchange
EFTPOS	Electronic Funds Transfer at Point of Sale
EIBG	European Intelligent Buildings Group
Gbit/s	Gigabits per second
GDP	Gross Domestic Product
GLC	Government-Linked Company
GNP	Gross National Product
GPC	Government Parliamentary Committee
GPS	Global Positioning System
GRC	Group Representation Constituency
HDB	Housing and Development Board
HRO	High Reliability Organisation
HVAC	Heating, Ventilation and Air Conditioning
IB	Intelligent Building
IBE	Intelligent Buildings in Europe
IBMS	Intelligent Building Management System
IBS	Intelligent Building System
ICT	Information and Communications Technology

ID	Identification
IQ	Intelligence Quotient
ISDN	Integrated Services Digital Network
IT	Information Technology
IT&T	Information Technology and Telecommunications
IVR	Interactive Voice Response
JTC	Jurong Town Corporation
Kbit/s	Kilobits per second
LAN	Local Area Network
LON	Local Operating Network
LONTalk	a proprietary protocol designed for LONs
LRO	Low Reliability Organisation
Mbit/s	Megabits per second
MLO	Murphy's Law Organisation
NAO	Normal Accidents Organisation
NCB	National Computer Board
NEC	NEC Corporation, previously known as Nippon Electric Company
NITP	National Information Technology Plan

NTT	Nippon Telegraph and Telephone Corporation
OA	Office Automation
ONE	One Network for Everyone
$p(x)$	probability of x occurring
PABX	Private Automatic Branch Exchange
PAP	People's Action Party
PBC	Parsons Brinckerhoff Consultants Private Limited
PC	Personal Computer
PCPL	POSBank Centre Private Limited
PERT	Programme Evaluation and Review Technique
PIN	Personal Identification Number
POSB	Post Office Savings Bank
POSBank	Post Office Savings Bank
PRA	Probabilistic Risk Analysis
QA	Quality Assurance
S\$	Singapore Dollars
SDH	Synchronous Digital Hierarchy
SNMP	Simple Network Management Protocol
SOPs	Standard Operating Procedures

SRA	Simple Risk Adjustment
STS	Shared Tenant Services
TAS	Telecommunication Authority of Singapore
TP	Turning Point
USA	United States of America
WAN	Wide Area Network